



**US Army Corps
of Engineers**

Construction Engineering
Research Laboratory

AD-A240 782



USACERL Technical Report P-91/44
September 1991

2

An Automated Approach to Global Trends Analysis for Installation Planning

by

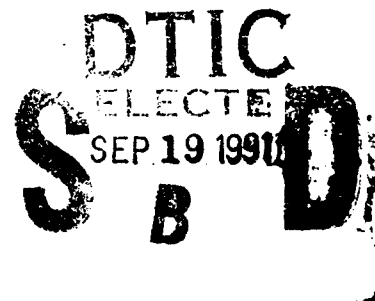
Ilker R. Adiguzel

T. John Kim

Deborah L. Fields

Effective strategic planning at the headquarters level must relate Army installations to the political, economic, demographic, environmental, and technological climate of the world as a whole. However, the ability of planners to synthesize the many issues and trends involved in long-range planning is limited by the mass of available data on constantly changing global conditions affecting Army installations.

TRENDS is a prototype intelligent data management system designed to help Army planners on the headquarters level keep abreast of global trends that affect long-range facilities plans. TRENDS models a dynamic process of locating information in, and incorporating new information into, a continuously updated database program. This microcomputer-based system uses a hyper-text interface to reference global trends by title, category, or keywords. The system summarizes expert information on the implications of selected trends, lists titles of additional source information, suggests names of associated trends, and explains the relationships between global trends. TRENDS includes a telecommunication package and accommodates the use of outside word processors to allow users to give feedback and expand the database with their experience, ideas, and expert knowledge.



Approved for public release; distribution is unlimited.

91-10797



001 11 008

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official indorsement or approval of the use of such commercial products. The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

DESTROY THIS REPORT WHEN IT IS NO LONGER NEEDED

DO NOT RETURN IT TO THE ORIGINATOR

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE September 1991	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE An Automated Approach to Global Trends Analysis for Installation Planning		5. FUNDING NUMBERS PE 62734 PR AT41 TA SA WU AG9		
6. AUTHOR(S) Ilker R. Adiguzel, T. John Kim, and Deborah L. Fields				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Construction Engineering Research Laboratory (USACERL) PO Box 9005 Champaign, IL 61826-9005		8. PERFORMING ORGANIZATION REPORT NUMBER TR P-91/44		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) HQ USACE ATTN: DAEN-ZCI-P 20 Massachusetts Avenue, NW. Washington, DC 20314-1000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) Effective strategic planning at the headquarters level must relate Army installations to the political, economic, demographic, environmental, and technological climate of the world as a whole. However, the ability of planners to synthesize the many issues and trends involved in long-range planning is limited by the mass of available data on constantly changing global conditions affecting Army installations. TRENDS is a prototype intelligent data management system designed to help Army planners on the headquarters level keep abreast of global trends that affect long-range facilities plans. TRENDS models a dynamic process of locating information in, and incorporating new information into, a continuously updated database program. This microcomputer-based system uses a hypertext interface to reference global trends by title, category, or keywords. The system summarizes expert information on the implications of selected trends, lists titles of additional source information, suggests names of associated trends, and explains the relationships between global trends. TRENDS includes a telecommunication package and accommodates the use of outside word processors to allow users to give feedback and expand the database with their experience, ideas, and expert knowledge.				
14. SUBJECT TERMS TRENDS army facilities		strategic planning trends analysis		15. NUMBER OF PAGES 28
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT SAR	

FOREWORD

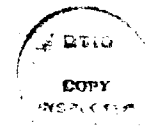
This investigation was performed for the Office of the Assistant Chief of Engineers (OACE), under project 4A162734AT41, "Military Facilities Engineering Technology"; Task SA, "Major Trends in Army Installation Planning"; Work Unit AG9, "Trends Effects on Installation Planning." The technical monitor was Mr. Stanley C. Shelton, DAEN-ZCI-P.

The work was performed by the Facility Systems Division (FS) of the U.S. Army Construction Engineering Research Laboratory (USACERL). The USACERL principal investigator was Dr. Ilker Adiguzel. Part of this research was conducted by the University of Illinois Department of Urban and Regional Planning, Expert Planning Systems Information Laboratory, under contract No. DACA88-90-D-0003. Dr. T. John Kim is a professor and Ms. Deborah L. Fields is a doctoral candidate in the Urban and Regional Planning Department. Dr. Michael J. O'Connor is Chief, USACERL-FS. The USACERL technical editor was Mr. William J. Wolfe, Information Management Office.

COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

CONTENTS

	Page
SF298	2
FOREWORD	2
1 INTRODUCTION	5
Background	
Objectives	
Approach	
Scope	
Mode of Technology Transfer	
2 DEVELOPMENT OF TRENDS STRUCTURE AND FUNCTIONS	7
Global Trends Database	
Related Trends	
Other Potential Trends	
Trends Relationships Analysis	
Bibliography Search	
Search of Articles by Keyword	
Writing Comments	
Communication Facility	
3 MAINTENANCE OF TRENDS	16
4 CONCLUSIONS AND RECOMMENDATIONS	18
APPENDIX A: Survey Forms Used To Identify Implications	19
APPENDIX B: Sample Data Sources	27
DISTRIBUTION	



Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

AN AUTOMATED APPROACH TO GLOBAL TRENDS ANALYSIS FOR INSTALLATION PLANNING

1 INTRODUCTION

Background

Effective strategic planning at the headquarters level must relate Army installations to the political, economic, demographic, environmental, and technological climate of the world as a whole. Army planners must identify and respond to those external factors that affect the goals of Army installations. There is a need for a broad and easily accessible knowledge base that encompasses information on such external global conditions to help Army planners develop the necessary programs and strategies to ensure that Army installations meet their stated goals. The data management capabilities of microcomputer-based systems offer the capabilities to develop such a knowledge base.

Objectives

The objectives of this project were to:

1. Identify literature sources of information of global trends, their interrelationships, and their implications for Army installations
2. Identify sources of expert knowledge on global trends, their interrelationships, and their implications for Army installations
3. Identify emerging global trends by name
4. Develop an information file for each identified trend
5. Create a prototype software system (TRENDS) that provides easy access to data on global trends, explains the interrelationship between trends, and suggests avenues for further investigation
6. Explore concepts for efficient update and expansion of a global-trends database.

Approach

A literature search was conducted to locate sources of information on global trends. Army planners were surveyed by mail and interviewed by telephone to discuss the direct and indirect implications of identified global trends on Army installations. Survey results were summarized and used as the basis for a work group organized to explore the effects of global trends on Army installation real property

management. The TRENDS database was developed using KnowledgePro,¹ a hypertext environment that links collected pieces of information in an associative way that helps users to learn and use the system.

Scope

This study was limited to the development of a prototype model of the TRENDS system.

Mode of Technology Transfer

Demonstrations of the TRENDS prototype were presented to the Army Master Planning Steering Committee, and to the Office of Strategic Initiatives, CESI. It is recommended that any working model developed from this prototype be incorporated into the Army Long-Range Facilities Plan.²

¹*KnowledgePro™*, IBM-PC version by Beverly and William Thompson (Knowledge Garden, Inc., Nassau, NY, 12123, 1988).

²*Army Long-Range Facilities Plan* (Headquarters, Office of the Assistant Chief of Engineers [HQOACE], 1989).

2 DEVELOPMENT OF TRENDS STRUCTURE AND FUNCTIONS

The TRENDS microcomputer-based system is a prototype intelligent data management tool designed for Army planners on the headquarters level involved in developing long-range facilities plans. The program provides efficient access to information on global conditions that affect Army installation operations. TRENDS uses a hypertext interface to reference global trends by title, category, keyword, or phrase. The system provides expert information and titles of associated literature on selected trends. TRENDS also suggests the names of associated trends that may be of interest, and explains relationships between global trends. TRENDS includes a feedback system that allows users to contribute their own experience and ideas to a dynamic database of expert information.

At present, TRENDS requires an IBM AT-compatible microcomputer with extended random-access memory (RAM), a graphics card, and at least 10 megabytes of hard disk space. Although the prototype TRENDS system was designed for Army headquarters planners, later developments may expand the TRENDS database to include information relevant to Army planners at all levels involved in general installation planning.

TRENDS is a user-friendly system. Users enter the KnowledgePro environment and select "TRENDS" to begin a session. TRENDS begins with a choice: either to begin an information session, or to read through instructions and a brief background on the development and use of the system. After invoking TRENDS, the user may choose from one of six options:

1. A database that includes information on political, economic, demographic, environmental and technological trends with potential implications on Army installations' real property management
2. A listing of other related trends that deserve attention by planners
3. An analysis of the relationships among global trends that provides a brainstorming exercise
4. A bibliography search of source articles by keywords
5. A capability to use an outside line editor or word processor via a "shell" to write messages to the system manager about ideas and comments on the global trends included in or excluded from the system, or simply to take notes
6. Direct user access to the system maintenance manager through a telecommunication system. TRENDS is programmed for connection with SmartCom III,* connecting users with the worldwide Programming, Administration, and Execution (PAX) system. Planners can send written comments to the system managers or to other planners. Users may also retrieve data from external databases.

*SmartCom III is a product of Hayes Microcomputer Products, Inc., PO Box 105203, Atlanta, GA 30348.

Global Trends Database

Users begin to scan the TRENDS database by selecting one of five categories of trends: political, economic, demographic, environmental, or technological. After making a selection, users are given a list of trends in that category to scan. Figure 1 presents a list of the 33 global trends included in the prototype TRENDS.

<u>POLITICAL</u> Soviet Union International Relationships Sharing the Burden of the Defense Budget Soviet Union Regional Issues Modernization of NATO Adoption of a National Service Conventional Forces Reduction in Europe The End of the Cold War Army Base Closings Joint Purchasing by Armed Forces
<u>ECONOMIC</u> The Value of the U.S Dollar The U.S Economy The Demand for Imported Oil and U.S Energy Privatization in America Soviet Union Economy U.S Economic Relationships with Asia European Economic Community 1992 Defense Spending
<u>DEMOGRAPHIC</u> U.S Labor Shortage and the Aging Population U.S Migration Pattern Urbanization Trends in Europe Role of Women U.S Education System Shortage of Engineers and Scientists U.S War on Drugs U.S Social Activism
<u>TECHNOLOGICAL</u> Simulation as a Training Tool Weapon Technologies Building Construction Materials
<u>ENVIRONMENTAL</u> Toxics and Air Pollution Control Hazardous Waste Cleanup Land Use Management Biological Diversity Risk Assessment

Figure 1. Global Trends Included in TRENDS.

Related Trends

Once a trend is selected, the program presents a database file of information on that trend. The information file includes a brief description of the global trend or issue, an archive of facts, a synopsis of the implications for Army installations, supplemental data, references, cross references, and a location list of additional information.

Other Potential Trends

TRENDS provides users information on other potential trends that have emerged that may deserve the attention of planners. This is a creative facility intended to stimulate the users' thinking. In the meantime, the system managers should investigate the implications of each new potential trend identified on Army installations to decide whether or not to include it in TRENDS. Users are encouraged to communicate to the system manager any knowledge they may have regarding the implications of these potential trends on Army installations' real property management, or to mention additional trends not included on the list or in TRENDS that deserve attention.

The information file was developed using data collected from the media, from topical literature, and from experts in the field. The progression from raw data to processed information is based on a filtering process set up to analyze direct and indirect relationships between data and the goals of Army installations. The goals for Army installations, set out in the "Army Long-Range Facilities Plan," are to: (1) provide quality living and working environments, (2) provide efficient and effective operations, (3) support future Army roles, (4) support future stationing requirements, (5) support modernizing systems, (6) support future training and development, and (7) foster environmentally responsible activities. Figure 2 depicts the complex interrelationship among these goals and the global factors influencing them. TRENDS is set up to capture such relationships and to help planners access the relevant information with minimal effort.

To speed the progress from raw to processed information, facts were collected about identified trends, and interviews and a work group were set up to discuss direct and indirect implications of the identified trends on the Army installations. Facts were collected through a 2-year literature search. Interviews with groups such as Environmental Studies Institute, and Arms Control, Disarmament, and International Security at the University of Illinois also provided facts about global trends. The collected facts were archived in an information file of supplemental data. This archive system allows users to research the history of the trend. For example, the information file of a chosen trend will give a listing of facts found in 1990. For a review of facts from 1989, the user may mouse-click the highlighted hypertext "[7/89 FACTS]" entry on the screen, or use the function keys (F3 to select a trend for further analysis, and F4 to view the contents of a trends entry). The archive system also helps in the maintenance of the TRENDS system (ch. 3, p 16).

As the program provides background facts about a chosen trend, it also gives an explanation of the trend's planning significance for Army installations' real property management. To relate global trends directly to Army installation goals, Army installation planners were surveyed, and follow-up telephone interviews were conducted. Appendix A includes a sample of the written survey and a list of interviewees. Survey results were collated, programmed into a matrix, and analyzed. A summary of the findings was prepared to lead a work group session.

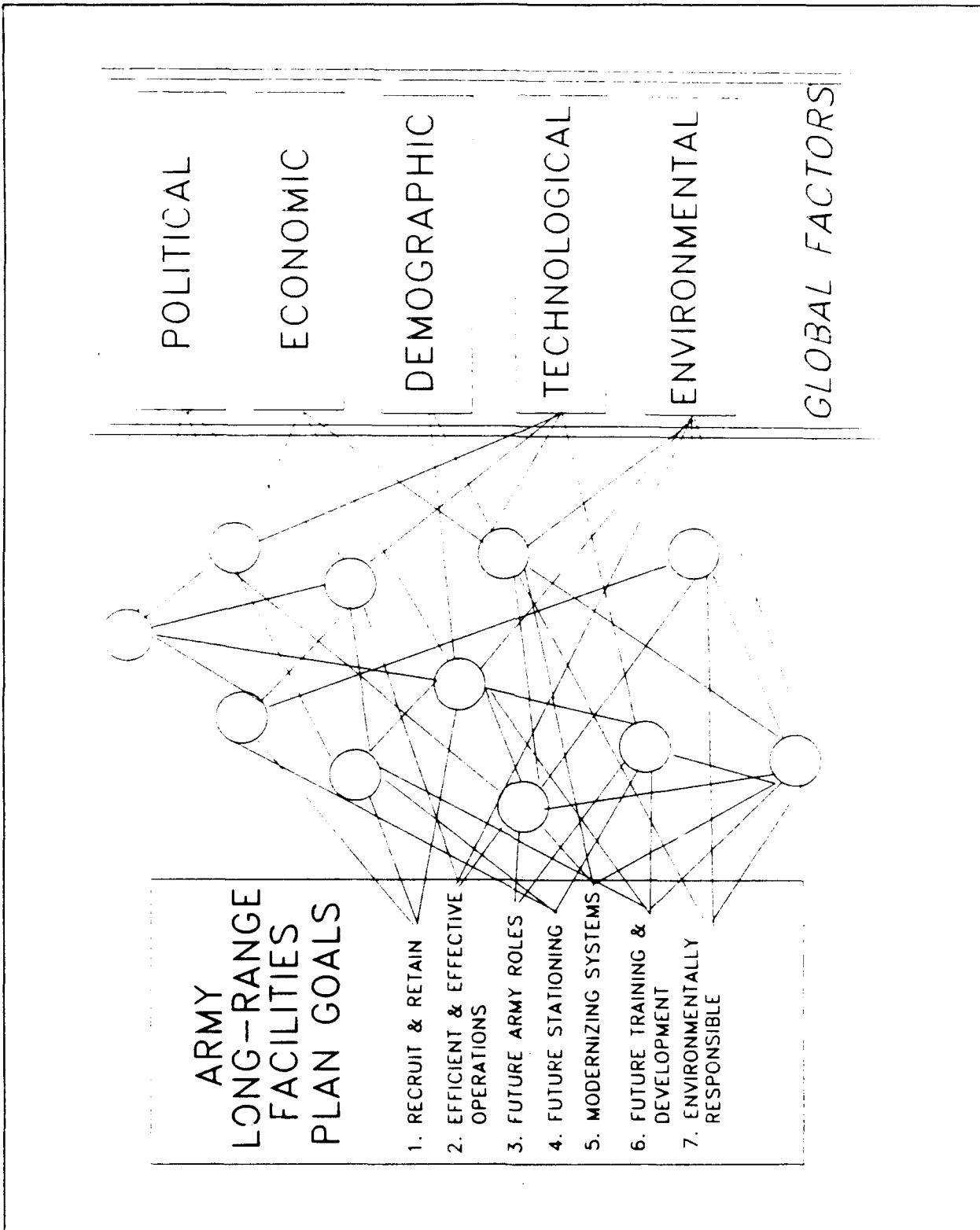


Figure 2. Long-Range Goal-Global Factor Relationships.

This work group included a number of Army planners, and was organized as a brainstorming session to explore the implications of global trends on Army installations' real property management. The work group also provided insight into the significance of particular trends and arrived at a consensus about the implications of some trends on Army installations' real property management. As a result of the work group session, a number of trends were added and deleted from the TRENDS system.

The implications supplied in TRENDS were developed using the conclusions of the work group, responses of the survey, and an analysis of the facts. The implications provided, however, are brief and only representative. They were developed specifically to define a process that would relate global trends and their implications. An exhaustive list of implications will be a later refinement of the program.

The development work on the implications provided useful insights into the TRENDS developmental process. For example, it was determined from the survey work and work group discussion that the planner surveys were not very useful and were too time-consuming. In fact, Army planners are not trend experts. Analysis of trends and their implications requires a collection of knowledge and expertise from many disciplines. Each Army planner has specialized knowledge about individual trends. To be useful, that knowledge gained from planners' responses should be ranked by importance.

Based on these experiences, future developments of TRENDS should follow these guidelines:

1. A set of experts on each trend should be identified and surveyed about the direction and potential implications of the trend in the future.
2. The system manager should be made responsible for synthesizing expert information and data scanned from the literature to develop the potential implications from each trend on Army installations' real property management.
3. The system manager should facilitate a brainstorming session with selected Army planners about the identified implications so that some consensus on the trends can be developed.
4. Once the implications are included in the TRENDS system, users of the system should be asked to give the system manager feedback on the implications. In this way, the system manager and the user can build more knowledge into the system about specific trends and their implications. This feedback mechanism is discussed in more detail in Chapter 3 of this report.

Following the presentation of the implications from the trend on Army installations' real property management, supplemental data is supplied. This supplemental data includes specific secondary information about the chosen trend that may assist planners to understand more clearly the implications of that trend on Army installation planning. Supplemental data may take the form of additional text, statistics, or graphics, and is accessed using hypertext links between information files and graphics, spreadsheets, databases, or text files. Graphic information (i.e., pie charts, maps, etc.) may, in turn, be linked to other data to give deeper knowledge on particular trends. For example, the information file for "Toxic Air and Pollution Control" contains a pie chart describing a list of what chlorofluorocarbons are used for, and each section of the pie chart is linked to additional information about chlorofluorocarbons.

Further development of TRENDS' supplemental data should focus on broadening the scope of data to include internal and external database sources related to specific trends. The communications facility (explained later in this Chapter) will help supplement this feature.

Trends Relationships Analysis

TRENDS Relationship Analysis is a brainstorming tool that shows relationships among global trends from a systematic perspective to highlight the implications of these relationships on Army installations' real property management. For example, if the user selected only one trend, e.g., "U.S Economy," TRENDS will also list those other trends that shape the implications on Army installation planning of "U.S Economy." Topics associated with "U.S Economy" would include: Army Base Closings; The Demand for Imported Oil; U.S Energy; European Economic Community, 1992; U.S Economic Relationships with Asia; Toxics and Air Pollution Control; Hazardous Waste Cleanup; U.S Labor Shortage and the Aging Population; and Defense Spending. In addition, if users want to explore these associated trends' implications on Army installations' real property management, they can mouse-click on any of the listed trends and an explanation of the implications will appear. The hypertext capabilities of the program link associated pieces of information.

The Relationships Analysis section demonstrates the need for future developments of TRENDS. Currently, the system only provides users a screen listing those trends with direct relationships to the implications of the chosen trend. However, to be a more effective brainstorming tool, TRENDS should track direct and indirect relationships. TRENDS should also allow users to track those relationships forward to see trends that are influenced by the chosen trend and backward to see trends that influence the chosen trend. Future development should include a graphic display of the relationships, to help users visualize the complex connections among trends in the environment.

It is difficult to understand the implications of global trends on Army installations because the relationships among trends, and the conditions that three or four trends can create in combination are complex. The Relationships Analysis of TRENDS will become a more powerful tool as the system grows in knowledge of the trends. For instance, rules can be developed from analyzing the impacts of the past trends on Army installations to build "what-if" scenarios. Such conjectural scenarios will help planners understand the global trends and their combined implications on Army installations' real property management by allowing planners to forecast the direction of the trends. In doing so, the planners can learn which trend (or combination of trends) is most critical to track to develop contingency plans for the consequences of those possible new conditions. In addition, some kind of ranking scheme would be useful to the TRENDS system. This way users could rank the significance of each trend and concentrate their efforts on more important trends. A system like the analytical hierarchy process (AHP), which assigns weighted criterion values to decision alternatives, may be a useful method to rank trends.

Bibliography Search

After TRENDS supplies supplemental data, the information file provides bibliographies of references collected from the literature about the trend. Each cited reference is stored in its complete text form in the TRENDS system. The user can access single references by mouse-clicking or by pressing the F3 and F4 keys on the highlighted number representing the reference. The user can then scan the entire article to obtain deeper knowledge about the trend. References included in trends cover the time period from 1988 to 1990. Appendix B contains a sample of data sources included in TRENDS.

After scanning articles of interest, the TRENDS user is given cross references to other trends in the program related to the selected trend. Each cross reference explains the relationship between trends, and

provides additional supporting references. The user may then call up the information file on the related trend. For example, the trend "European Economic Community 1992" is cross referenced to "The Value of the U.S Dollar" and "The End of the Cold War." This facility assists the user to develop a more complete picture of the trends that influence Army installations and the implications of these trends on real property management.

Relationships among trends were identified using the data collected from the literature search and a survey. A survey was also conducted of the Army installation planners to explore their level of knowledge about the interrelationships among global factors. But, as found with the survey conducted of the implications, Army planners are not specialists in the relationships among global trends. Each planner has a specific level of knowledge; unless that knowledge is quantified and ordered, it is difficult to use the results of the surveys. Therefore, Army planners' expert knowledge should be ranked by importance before incorporating it into the TRENDS database.

Finally, TRENDS provides users with locations of additional information on each subject. This aspect gives interested planners access to more information on particular trends. Future program development should provide a complete listing of institutes, agencies, and experts for each trend. The prototype program gives only brief source citations. Figure 3 shows a sample TRENDS information file.

Search of Articles by Keyword

TRENDS includes a keyword-search capability to help Army planners learn about the global trends influencing Army installations and understand the constraints and opportunities involved in achieving the desired goals. This search facility links articles collected in the literature scan to an index by keyword. The user can access a list of articles related to specific topics of interest by selecting one item from a list of keywords on the screen, or by specifying a keyword or phrase. TRENDS associates related information with predefined categories (economic, political, demographic, technological, and environmental) and subject terms.

Development of this facility requires that keywords be defined for each article included in TRENDS. The system manager should be responsible for developing keywords. Keywords may also represent ideas which emerge from an article, that the system's manager assumes will lead the user to identify constraints and opportunities.

Writing Comments

While TRENDS is running, the user may use a separate line editor or word processor to write to the system manager on the global trends included or excluded in the system, and their implications and interrelationships. Users can also use this feature to keep personal notes while using the TRENDS system, or to write notes to other planners. This facility is critical to the maintenance of the TRENDS system.

ENVIRONMENTAL-HAZARDOUS WASTE CLEANUP

ISSUE:

The United States produces over 260 million metric tons of hazardous waste each year - more than 1 ton for every person in the country. Through pollution of the air, the soil, and the water supplies, hazardous substances pose both short- and long-term threats to human health and environmental quality.

[7/90] FACTS:

The chief producers of hazardous wastes are the chemical and petrochemical industries. The military generates about 750,000 tons of hazardous wastes annually. For over half a century, untold amounts of fuels, oils, solvents, paints, sludges, acids, heavy metals, asbestos, and noxious chemicals have been disposed of by open burning, dumping in lagoons and landfills, or pouring down sewers. Estimates of the number of U.S. hazardous waste disposal sites vary, but at least 15,000 uncontrolled hazardous waste landfills have been identified in the U.S., along with 80,000 contaminated surface lagoons. Curtailing the production of hazardous radioactive substances may be the most critical of all hazardous waste challenges, as many of these substances have no known technological detoxifiers and will remain dangerous for thousands of years. U.S. DOE operates 14 weapons-related nuclear reactors. An investigation by the U.S. General Accounting Office discovered radioactive materials in the groundwater at DOE nuclear weapons facilities at Hanford, Washington, and at the Savannah River plant in Aiken, South Carolina. The radiation of the drinking water was over 400 times greater than the proposed drinking water standard. The greatest problem facing the nuclear industry, both commercial and federal, is that no long-term solution for waste disposal has been developed. Disposing of waste from the nuclear industry is becoming increasingly expensive. The Department of Energy estimates costs of \$100 billion just to clean up its nuclear weapons facilities.

IMPLICATIONS:

As environmental concerns over hazardous wastes increase, Army installations will be held responsible for any wastes deemed hazardous that are generated on an installation. Such wastes include solvents used in degreasing operations, paints, caustics, and corrosives. Also, print plants and photo labs generate hazardous wastes such as fixers, developers, and inks. Hospital laboratories use formaldehyde and picric acid. Plus, any facility with a generator will have hazardous wastes. Airfields use solvents and handle JP4. Real property management is affected as training programs will be required to teach soldiers about hazardous wastes and how to properly dispose of them. Each installation will be financially responsible for disposing of hazardous wastes by 1991. Special arrangements must be made to dispose of these wastes.

SUPPLEMENTAL DATA:

Toxic Substances Discharged by U.S. Industry, 1987
Hazardous Waste Management Methods, United States, 1983
U.S. Hazardous Waste Sites, 1988

REFERENCES:

Hamilton, Minard, "The Nuclear Waste Dilemma," *USA Today*, March 1989, pp.44-45.
Laws, Alice F., "Compliance: Staying out of Ecological and Legal Trouble," *Army Trainer Summer*, Summer 1990, pp.14-18.
Kosowatz, John J., "Cleaning up after the Military," *ENR*, May 25, 1989, pp.82-84.
Marbach, William; Susan E. Katz and Dody Tsiantar, "What to do with our Waste," *Newsweek*, July 27, 1987, pp. 51-52.
Roos, Jogn G., "DoD Looking for Ways to Destroy Toxic Stockpile," *Armed Forces Journal International*, May 1989, p.18.
Satchell, Michael, "Uncle Sam's Toxic Folly," *U.S. News and World Report*, March 27, 1989, pp.20-22.
Smart, Tim, "Troubled Waters," *Business Week*, October 12, 1987, pp.89-104.
Thurman, Skip, "Colorado Hazardous-Waste Cleanup Stirs Up Controversy," *Christian Science Monitor*, January 5, 1989.
Toufexis, Anastasia, "The Dirty Seas," *Time*, August 1, 1988.

CROSS REFERENCES:

Social Activism
Conventional Forces Reduction in Europe
Land Use Management

ADDITIONAL SOURCES:

Army Corp. of Engineers-Environmental Program
Board of Army Science and Technology
EPA Superfund Priorities List
Resource Conservation and Recovery Act (RCRA)

Figure 3. Sample TRENDS information file.

Communication Facility

KnowledgePro provides for connections with external programs. To coordinate communications between the users and the system manager, TRENDS is linked to *SmartCom III*, a modem communications software. This system allows users to send their comments to the system manager via the PAX system. The communications facility is central to maintenance of the system. Through the PAX system, users can also retrieve updated versions of TRENDS as they evolve. The communications facility also gives users access to external databases. The communications facility will also allow users to share their ideas with other TRENDS users, and in doing so, allows for the possibility of brainstorming.

3 MAINTENANCE OF TRENDS

Maintaining the TRENDS system is central to its usefulness as a strategic planning tool. Global trends change rapidly and new trends constantly emerge to influence those that already exist. This section provides guidance on how the TRENDS system should be maintained based on experiences from a 2-year development process. This section also discusses alternatives for implementation of the TRENDS system as a planning tool for Army planners.

Maintenance of TRENDS is facilitated through the system manager, who will also distribute updated versions of the software through the PAX system. The system manager is responsible for ongoing development of TRENDS, including:

1. Identifying a contact person at institutes and agencies in various fields to provide expert knowledge on the implications of and interrelationships among global trends. Person-to-person interviews and surveys should be used to gather this knowledge from the contacts.
2. Scanning the literature for new information and data on the global trends and their implications and interrelationships. In doing so, the system manager will identify emerging trends and associated keywords to facilitate TRENDS' search capability.
3. Synthesizing the information and knowledge collected from the experts and the literature search, and updating/developing an information file for each trend.
4. Organizing a work group of key Army planners and leading that group through a brainstorming activity on the implications of global trends on Army installations' real property management.
5. Integrating new insights gained from the work group into the information file.
6. Providing Army planners with copies of the TRENDS changes on a regular basis.
7. Receiving comments from the users of TRENDS. The comments should guide the system manager's scanning activity for literature and expertise. Comments from the users will provide insights to the system manager on the past and potential future implications from the global trends on Army installations' real property management.

To meet these requirements, TRENDS will require a centrally organized system within the Corps of Engineers, structured like the Office of Strategic Initiatives or the newly organized Army Environmental Policy Institute (AEPI). There are a number of good centralized maintenance arrangements. For instance, system maintenance could be contracted out to a research institute or through a university. One such relationship exists between the U.S. Army Construction Engineering Research Laboratory (USACERL) and the University of Illinois Department of Urban and Regional Planning, to maintain the Environmental Technical Information System (ETIS). A similar outside institute might maintain the TRENDS system.

On the other hand, the Corps of Engineers may wish to maintain the system itself, either solely or by dividing the task between several offices. One or two full-time personnel at the central location might be made responsible for TRENDS' maintenance. The experiences of the 2-year development of the prototype version of TRENDS show that this option would benefit the further development of TRENDS.

Full-time maintainers whose jobs are focused on a single system would be best able to manage and synthesize external and internal knowledge about global trends.

Another possibility is to distribute the maintenance of TRENDS among a number of offices within the Army Corps of Engineers. Separate offices would maintain information on specific trends. Specific updating guidelines and a synchronized mechanism would be essential to this scheme. Still, communications to a central office would be required to ensure consistencies and for final distribution.

Whatever arrangement is chosen, final hardware and software options must also be determined. Implementation of TRENDS requires that all planners use computers consistently configured to run TRENDS and its supporting software. In its current form, KnowledgePro has specific requirements for extended RAM memory, a graphics card, and about 10 megabytes of hard disk space. Future developments should consider the Windows version of KnowledgePro. This version provides a programming flexibility that could make future developments of TRENDS more comprehensive and user-friendly.

A Macintosh® computer-based system should also be considered for implementation of TRENDS. Benefits from Mac use would include the time saved by the system manager in programming. In addition, while IBM-compatible software is catching up, Mac graphics and video display facilities could enhance the learning environment of TRENDS significantly. In its current form, TRENDS has limited graphics capabilities and requires use of a separate conversion program to format graphics files for use with KnowledgePro.

The maintenance of TRENDS is critical. Before the system is implemented, a plan should be developed to explicitly deal with the issues set out above. For TRENDS to provide the important planning function that the prototype promises, it will require a full-time maintenance system. TRENDS may also develop into a generic planning tool, useful to the entire Army Corps of Engineers by subscription to individual units or branches. These offices could also contribute to the TRENDS database to expand the body of information on the impacts of global trends on their specific goals and objectives.

4 CONCLUSIONS AND RECOMMENDATIONS

The prototype TRENDS system demonstrates the potential usefulness of an intelligent database management system to strategic planning. TRENDS provides an efficient process for bringing information to Army planners on important global trends and their implications for Army installations' real property management.

Among other sources, this study attempted to identify Army planners as sources of expert knowledge on global trends, their interrelationships, and their implications for Army installations. A literature search identified text, tabular, graphic, and expert sources of information of global trends. Emerging global trends were identified by name, associated keywords were listed, and an information file was developed for each identified trend. A prototype software system was created that provides easy access to data on global trends, explains the interrelationship between trends, and suggests avenues for further investigation. Several concepts for efficient update and expansion of the TRENDS database were proposed.

It was found that Army planners often have a specialized knowledge of individual global trends and their implications, but that they are not usually expert sources on the relationships between global trends that span many disciplines. Later versions of TRENDS should draw on these and additional sources to create and maintain a broad, interconnected database on global trends and their implications. Information for this database should be reviewed and ranked by importance by a system manager before entry into the system.

TRENDS incorporates expert knowledge with representative indexed information from the print media, and source listings to create an information file on each identified global trend. Future development of the program will depend on the expansion of these sources to include complete listings of institutes, agencies, and experts to supplement the information files.

The TRENDS database is organized to become a dynamic information receptacle. The prototype system accommodates use of an outside line editor or word processor, and is designed to include a telecommunication connection with the PAX system to help gather users' comments and suggestions, and new expert knowledge, for incorporation into the system. The system should be organized and maintained centrally to simplify the development and expansion of the TRENDS database. The TRENDS system manager should be charged with review, organization, and entry of new database information, and with distribution of new TRENDS files. However, actual data collection may be assigned to one or several offices, either within the Corps of Engineers, or through a cooperative arrangement with a research institute or university.

APPENDIX A: Survey Forms Used To Identify Implications

PART I: Define 7 Goals

For each goal identified in the "Army Long-Range Facilities Plan," the respondent¹ is to define as specifically as possible what the goal means in terms of real property management.

1. Support the Army's ability to recruit and retain a motivated, well-trained military and civilian force by providing quality living and working environments.
2. Support the force through the efficient and effective operation of installations resulting from quality productive work and living environments, and effective management techniques.
3. Support future Army roles, missions, and warfighting doctrines with facilities that sustain forward deployment, mobilization, and rapid worldwide troop deployment requirements.
4. Support the Army's evolving force structure and future stationing by properly aligning installation support capabilities with unit stationing requirements.
5. Support modernizing warfighting systems and emerging technologies to maintain the U.S. military prowess as a lethal fighting force.
6. Support future training to assure development of a quality career force that is technically proficient and adaptable.
7. Operate installations and conduct Army activities in an environmentally responsible manner.

PART II: Each respondent is asked to rank the significance of each identified global factor with respect to its implications on the seven goals defined in Part I. Each trend is to be ranked such that:

- 0 = NO IMPACT, NOT SIGNIFICANT
- 1 = SMALL IMPACT, SOMEWHAT SIGNIFICANT
- 2 = MEDIUM IMPACT, SIGNIFICANT
- 3 = LARGE IMPACT, VERY SIGNIFICANT.

¹ Interviews were organized in two parts. The first part asked planners to define, using specific examples, the seven goals set out for Army installations in "Army Long-Range Facilities Plan, November 1989." The second part asked planners to discuss the significance of each trend on each of the seven goals. Thirteen Army planners were interviewed, including: Stanley C. Shelton (DAEN-ZCI-P), John Sheehey (CEMP-P), Mark Flemming (HQTRADOC,ATEN-SI), Greg Brewer (DAFN-ZCI-P), Warren Fee (CEMP-EA), Jack Cox (AFZA-DE-PM), Kristine Allaman (CEHSC-FP), John Anderson (HQFEAK,EAFE-EPS-MP), Charles McGee (USAED, Savannah), Stewart Grayson (CEHSC-FP-B), Ed Irish (CEHSC-FP-P), Byron Brown (USMA,MAEN-P), and Jim Askew (R&K Engineering, Inc.)

1. Support the Army's ability to recruit and retain a motivated, well-trained military and civilian force by providing quality living and working environments.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

2. Support the force through the efficient and effective operation of installations resulting from quality productive work and living environments, and effective managements techniques.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

3. Support future Army roles, missions and warfighting doctrines with facilities that sustain forward deployment, mobilization, and rapid worldwide troop deployment requirements.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

4. Support the Army's evolving force structure and future stationing by properly aligning installation support capabilities with unit stationing requirements.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

5. Support modernizing warfighting systems and emerging technologies to maintain the U.S. military prowess as a lethal fighting force.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

6. Support future training to assure development of a quality career force that is technically proficient and adaptable.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

7. Operate installations and conduct Army activities in an environmentally responsible manner.

POLITICAL

Soviet Regional Issues
European Economic Community 1992
Sharing the Burden of the Defense Budget in Europe
Frictions in NATO over Short-Range Missile Modernization
Adoption of a National Service
Unilateral Conventional Forces Reduction in Europe
U.S. Relationships with Asia
The End of the Cold War
Panama and Noriega
Defense Spending
Army Base Closings
Joint Purchasing by Armed Forces
Strategic Defense Initiative (SDI) Funding

ECONOMIC

U.S. Economy and Recessionary Condition
The Value of the U.S. Dollar
U.S. Twin Deficits
The Rising Demand for Imported Oil
Privatization in America
The Soviet Economy

DEMOGRAPHIC

U.S. Labor Shortage and the Aging Population
U.S. Migration Pattern
Shortage of Service-Eligible Manpower in Europe
Urbanization in Europe, particularly W. Germany
Role of Women
Education Level
Shortage of Engineers
Shortage of Nurses
U.S. War on Drugs
A New Era of Social Activism
Improving the Military Health Service System

TECHNOLOGICAL

Simulation as a Training Tool
Automated Weapons Systems

ENVIRONMENTAL

Acid Rain Legislation
Hazardous Waste Cleanup
Toxics and Air Pollution Control
Supplies of Tritium

APPENDIX B: Sample Data Sources

DAILY

Christian Science Monitor
New York Times
Washington Post

WEEKLY

Economist
U.S. News & World Report
Congressional Quarterly
Jane's Defense Weekly
Aviation Week & Space Technology
Forces
World Press Review
Science
Newsweek
Time

MONTHLY

Bulletin of the Atomic Scientists
Armed Forces Journal International
Economic Review
Petroleum Economist
Monthly Energy Review
The Futurist
National Defense
Social Policy
Army
Lasers & Optronics
The Washington Monthly
Arms Control Today
Soldiers

QUARTERLY REPORTS

Urban Land
The Conference Board
Foreign Affairs
Country Reports
The Brookings Review International Financial Statistics
CATO Institute Policy Analysis

YEARLY REPORTS

Economic Report of the President
Budget for Fiscal Year 1989
World Population by Country and Region
Congressional Budget Office
World Bank Annual Report